Small Business Innovation Research/Small Business Tech Transfer

Validated Engineering Tools for Thin-Ply Composites, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Opterus Research and Development, Inc. proposes to develop and validate multi-scale thin-ply High Strain Composites (HSCs) constitutive modeling tools for incorporation into commercial finite element analysis codes. The constitutive models will capture the time-temperature-load-deformation viscoelastic characteristics common to HSCs as well as the yielding or permanent deformation associated with the large strains HSC materials are subjected to. The two main program components are 1) characterization of thin-ply HSCs through extensive testing and 2) multi-scale modeling of thin-ply HSCs at the constituent (matrix and fiber), lamina, and laminate levels. Of particular interest are modeling and characterizing the unique behaviors of highly spread tow woven textile HSCs. This combination of characterization and modeling will enable validated engineering tools to allow the predictive design of thin-ply HSC structures.

Anticipated Benefits

Primary NASA applications are thin-ply deployable composite hinges and booms for small satellite applications. These booms, including double-omega, shearless, slit-tube, tape-spring, and TRAC booms, are rolled on small diameter hubs. The booms can then be used to deploy solar sails, reflectors, antennas, solar arrays, sun shades, deorbit sails, sensor booms, etc. The thin-ply deployable composite hinges and booms are broadly applicable to NASA missions involving deployable structures and HSCs.

Applications include the range of solar sails, reflectors, antennas, solar arrays, sun shades, deorbit sails, sensor booms, etc. The technology is enabling for higher compaction, lighter weight systems and supports development and engineering processes that are faster and lower cost. Savings are achieved through a reduction in the number of iterative build and test cycles needed in development programs because system performance can be predicted more accurately prior to prototype fabrication

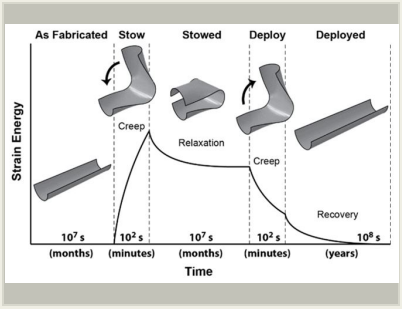

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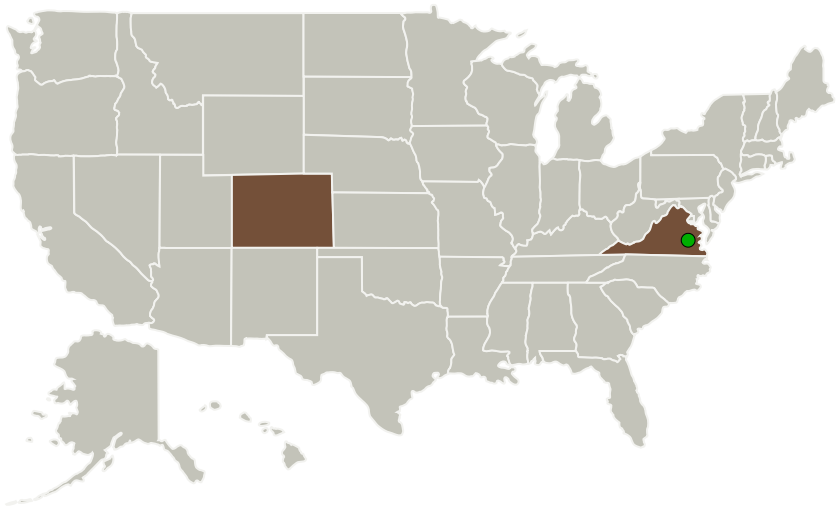
Table of Contents

Validated Engineering Tools for Thin-Ply Composites, Phase I

Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Opterus Research and Development, Inc.	Lead Organization	Industry	Fort Collins, Colorado
Colorado State University-Fort Collins	Supporting Organization	Academia	Fort Collins, Colorado
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Colorado	Virginia

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Opterus Research and Development, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

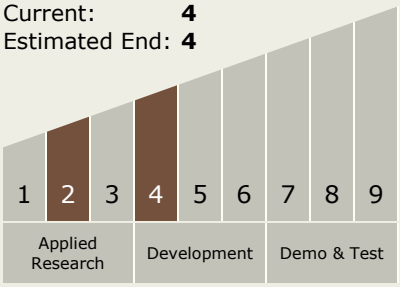
Carlos Torrez

Principal Investigator:

Thomas Murphey

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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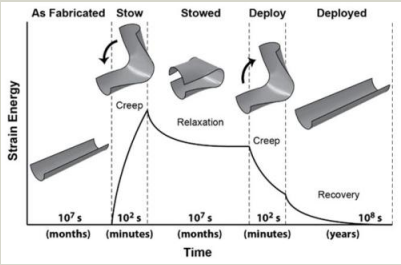
August 2019: Closed out

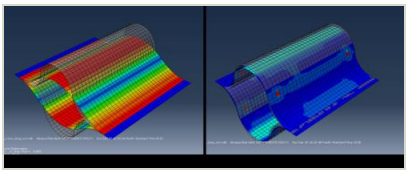
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140140)*

Images



Briefing Chart Image
Validated Engineering Tools for Thin-Ply Composites, Phase I *(https://techport.nasa.gov/image/133723)*



Final Summary Chart Image
Validated Engineering Tools for Thin-Ply Composites, Phase I *(https://techport.nasa.gov/image/135156)*

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.3 Mechanical Systems
    - TX12.3.1 Deployables, Docking, and Interfaces

Target Destination

Earth